

Claims

- [c1] 1. A method of designing a manufacturing process line for a vehicle closure, the method comprising:
identifying a manufacturing process comprising a set of discrete steps to be performed on at least one work-piece;
identifying a plurality of standardized work cells, each work cell having at least one standardized workpiece presenter that supports a workpiece in a predefined spatial orientation, and at least one standardized processing tool;
selecting a subset of the set of discrete steps to be performed at a work cell and selecting the standardized work cell for performing the subset of steps; and
repeating the selecting step for additional subsets of steps to be performed at one of the plurality of work cells until all of the discrete steps are assigned to one of the plurality of work cells.
- [c2] 2. The method of claim 1 wherein a plurality of manufacturing process lines are identified as templates.
- [c3] 3. The method of claim 2 wherein the manufacturing process line is completely designed by specifying a plu-

ality of templates in a defined sequence.

- [c4] 4. The method of claim 1 wherein the workpiece presenter and processing tool are interrelated with an integrated standard control system.
- [c5] 5. The method of claim 1 wherein a first work cell comprises the standardized workpiece presenter comprising a pedestal welding work cell having a robotic arm for picking up and moving workpieces from a fixture to the processing tool selected from the group consisting essentially of a pedestal welder, a sealant dispensing unit, and a projection weld gun.
- [c6] 6. The method of claim 5 wherein a second work cell comprises the standardized workpiece presenter comprising a multiple sided trunnion fixture having a plurality of fixtures for a plurality of workpieces that are rotated about a horizontal axis and the processing tool is selected from the group consisting essentially of a welding robot and a sealant applicator.
- [c7] 7. The method of claim 6 wherein a third work cell comprises the standardized workpiece presenter comprising a fixture in a tool and the processing tool is selected from the group consisting essentially of a hemming tool, a clinching tool, and a piercing tool.

- [c8] 8. The method of claim 1 wherein the closure is a vehicle passenger compartment door.
- [c9] 9. The method of claim 1 wherein the closure is a vehicle trunk lid.
- [c10] 10. The method of claim 1 wherein the closure is a vehicle hatchback.
- [c11] 11. The method of claim 1 wherein the closure is a vehicle engine compartment hood.
- [c12] 12. A manufacturing process line for making a vehicle closure, the manufacturing process line comprising:
a first template having a plurality of work cells including:
a pedestal welding work cell having a robotic arm for picking up and moving a workpiece to a processing tool selected from the group consisting essentially of a pedestal welder, a sealant dispensing unit, and a projection weld gun; and
a trunnion work cell having a multiple sided trunnion fixture that is rotated about a horizontal axis to position the workpiece near a second processing tool selected from the group consisting essentially of a welding robot and a sealant applicator;
wherein the plurality of work cells are arranged in a pre-determined sequence such that at least one trunnion

work cell is disposed between consecutive pedestal welding work cells.

[c13] 13. The manufacturing process line of claim 12 comprising three pedestal welding work cells and four trunnion work cells.

[c14] 14. The manufacturing process line of claim 13 wherein the first, third, and sixth work cells are pedestal welding work cells and the second, fourth, fifth, and seventh work cells are trunnion work cells.

[c15] 15. The manufacturing process line of claim 14 further comprising a material handling robot for transporting workpieces between the second work cell and the third work cell.

[c16] 16. The manufacturing process line of claim 12 further comprising a second template having a plurality of work cells arranged in a predetermined sequence, the work cells including:
a pedestal welding work cell;
a trunnion work cell; and
a hem clinch work cell including a fixture and a processing tool, the processing tool selected from the group consisting essentially of a hemming tool, a clinching tool, and a piercing tool;

wherein the second template receives the workpiece from the first template and performs additional operations on the workpiece to complete fabrication of the closure.

[c17] 17. The manufacturing process line of claim 16 comprising one pedestal welding work cell, one trunnion work cell, and two hem clinch work cells.

[c18] 18. The manufacturing process line of claim 17 wherein a first work cell is a trunnion work cell, a second work cell is a pedestal welding work cell, and third and fourth work cells are hem clinch work cells.

[c19] 19. The manufacturing process line of claim 18 wherein the first work cell is configured with a sealant dispensing unit as the processing tool.

[c20] 20. The manufacturing process line of claim 16 further comprising a material handling robot for transporting the workpiece from the second work cell to the third work cell and from the third work cell to the fourth work cell.